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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
AL NAZER, LEITH A	
ART UNIT	**PAPER NUMBER**
2821	

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/996,143	FRICK, ROGER L.
	Examiner	Art Unit
	Leith A Al-Nazer	2821

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 June 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10,12-31 and 33-66* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5-10,12,13,17,18,20,22-28,31,33-37,40-64 and 66* is/are rejected.

7)☒ Claim(s) *4,14-16,19,21,29,30,38,39 and 65* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 November 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. New corrected drawings in compliance with 37 CFR 1.121(d) are required in this application because the drawings filed on 28 November 2001 are informal and are suitable only for examination. Applicant is advised to employ the services of a competent patent draftsperson outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

Allowable Subject Matter

2. Claims 4, 14-16, 19, 21, 29, 30, 38, 39, and 65 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-3, 5-8, 12, 17, 18, 20, 22-27, 31, 33-37, 40-43, 45, 46, 48-52, 54, 55-61, 63, 64, and 66 are rejected under 35 U.S.C. 102(b) as being anticipated by Hicks, Jr. et al '087.

With respect to claim 1, Hicks teaches an optical sensor apparatus comprising an optical resonator (14) disposed to receive at least a portion of the pulsed laser energy (S), the optical resonator having a waveguide (figure 1) comprising a first dielectric (18), a cavity defining a variable gap (22; figure 4) comprising a second dielectric different than the first dielectric, and a sensing surface (column 5, lines 5-10) positioned to vary the variable gap in response to changes in the measurable parameter at the sensing surface such that the repetition rate of the pulsed laser energy changes in response to changes in the measurable parameter.

With respect to claim 2, Hicks teaches the sensing surface being an outer surface of the waveguide (column 5, lines 5-10).

With respect to claim 3, Hicks teaches the waveguide further comprising a core (18) and a cladding (20) surrounding the core such that at least a portion of the laser energy propagates within the core under total internal reflection (figure 4).

With respect to claim 5, Hicks teaches the cavity (22) being disposed entirely within the cladding (20).

With respect to claim 6, Hicks teaches the optical resonator further comprising a first reflector at an entrance end of the optical resonator and a second reflector at an exit end of the optical resonator (column 2, lines 18-35).

With respect to claim 7, Hicks teaches the optical resonator being a ring resonator (figures 12 and 13; column 2, lines 18-35).

With respect to claim 8, Hicks teaches the ring resonator being formed of an optical fiber (figures 12 and 13; column 2, lines 18-35).

With respect to claim 12, Hicks teaches the measurable parameter being selected from the group consisting of pressure, temperature, flow rate, material composition, force, and strain (column 5, lines 5-10).

With respect to claim 17, Hicks teaches a measuring apparatus for measuring the repetition rate of the laser energy (E in figures 1, 3, 6, 13, and 15).

With respect to claim 18, Hicks teaches the optical resonator (14) being external to the mode-locked laser source (S; figure 1).

With respect to claims 20, 33, and 34, Hicks teaches an optical sensor apparatus comprising an optical resonator (14) having a waveguide comprising a first dielectric (18), a cavity defining a variable gap (22) comprising a second dielectric different than the first dielectric, and a sensing surface (column 5, lines 5-10) positioned to vary the variable gap in response to changes in the measurable parameter at the sensing surface, the optical resonator defining a resonant frequency that varies in response to variations in the variable gap, the optical resonator being disposed such that a laser signal from the optical sensor apparatus has a frequency at the resonant frequency.

With respect to claim 22, Hicks teaches the optical resonator forming a resonator that is external to the laser source (figure 1).

With respect to claim 23, Hicks teaches the measurable parameter being a physical parameter that applies a force to the sensing surface for varying the variable gap (column 5, lines 5-10).

With respect to claim 24, Hicks teaches the waveguide comprising a core (18) and a cladding (20) surrounding the core such that the laser signal propagates within the core under total internal reflection.

With respect to claim 25, Hicks teaches the waveguide further comprising a first reflector at an entrance end of the optical resonator and a second reflector at an exit end of the optical resonator (column 2, lines 18-35).

With respect to claim 26, Hicks teaches the waveguide comprising a ring resonator (figures 12 and 13).

With respect to claim 27, Hicks teaches the physical parameter being selected from the group consisting of pressure, temperature, flow rate, material composition, force, and strain (column 5, lines 5-10).

With respect to claim 31, Hicks teaches a measuring apparatus (E in figure 1) for measuring the frequency of the laser signal.

With respect to claims 35 and 64, Hicks teaches a modulating apparatus comprising a coupler (A in figure 1) coupled to receive laser energy; a sensing surface (column 5, lines 5-10); and an external high Q resonator (14) characterized by a resonant frequency that varies in response to changes in the measurable parameter, the high Q resonator coupled to the coupler for modulating the laser energy into an information carrying laser signal having a frequency at the resonant frequency of the

high Q resonator, wherein the measurable parameter is a physical parameter creating a change in a force applied to the sensing surface to vary the resonant frequency (column 5, lines 5-10).

With respect to claim 36, Hicks teaches the coupler being a waveguide coupler (figure 1).

With respect to claim 37, Hicks teaches the physical parameter being selected from the group consisting of pressure, temperature, flow rate, material composition, force, and strain (column 5, lines 5-10).

With respect to claim 40, Hicks teaches a variable frequency resonator comprising an optical resonator (14) having a sensing surface (column 5, lines 5-10) and having a waveguide having a cavity defining a variable gap (22; figure 4), the optical resonator characterized by a resonant frequency that is dependent upon the variable gap which is disposed to alter the resonant frequency of the optical resonator in response to changes in a measurable parameter at the sensing surface (column 5, lines 5-10).

With respect to claim 41, Hicks teaches the optical resonator comprising a first reflector disposed at an entrance face of the waveguide and a second reflector disposed at an exit face of the waveguide, the first reflector and second reflector defining a resonant length through the waveguide (column 2, lines 18-35).

With respect to claim 42, Hicks teaches the waveguide being an optical fiber having a core (18) and a cladding (20).

With respect to claim 43, Hicks teaches the waveguide being a ring resonator (figures 12 and 13).

With respect to claims 45 and 49, Hicks teaches a method of sensing a measurable parameter, the method comprising providing a laser signal (S); providing a resonator (14) characterized by a resonant frequency; providing a waveguide comprising a first dielectric (18) and a cavity defining a variable gap (22) comprising a second dielectric different than the first and that varies in response to changes in the measurable parameter, where variations to the variable gap alter the resonant frequency; propagating at least a portion of the laser signal through the resonator such that the laser signal has a frequency at the resonant frequency; and sensing changes in the measurable parameter (column 5, lines 5-10) based on the frequency of the propagated laser signal.

With respect to claim 46, Hicks teaches placing a first reflector at an entrance side of the first dielectric; and placing a second reflector at an exit side of the first dielectric, where the first reflector is partially transmissive at the frequency of the laser signal (column 2, lines 18-35).

With respect to claim 48, Hicks teaches the laser signal being produced by a laser source and the resonator being external to the laser source, propagating the laser signal further comprising coupling the laser signal from the laser source to the resonator (figure 1).

With respect to claim 50, Hicks teaches sensing changes in the measurable parameter comprising the step of providing a sensing surface communicating with the variable gap (column 5, lines 5-10).

With respect to claims 51 and 56, Hicks teaches a method of sensing a measurable parameter, the method comprising the steps of providing a pulsed laser signal (S) characterized by a repetition rate; providing a resonator (14) comprising a waveguide formed of a first dielectric (18); providing a cavity (22) defining a variable gap formed of a second dielectric different than the first and that varies in response to changes in the measurable parameter; propagating at least a portion of the pulsed laser signal through the resonator such that the repetition rate of the pulsed laser signal changes in response to variations in the variable gap; and sensing changes in the repetition rate in response to variations in the variable gap (column 5, lines 5-10).

With respect to claim 52, Hicks teaches placing a first reflector at an entrance side of the first dielectric; and placing a second reflector at an exit side of the first dielectric, where the first reflector is partially transmissive at the frequency of the laser signal (column 2, lines 18-35).

With respect to claim 54, Hicks teaches providing a sensing surface communicating with the variable gap (column 5, lines 5-10).

With respect to claim 55, Hicks teaches the pulsed laser signal being produced by a mode-locked laser source and the resonator being external to the mode-locked laser source, propagating the pulsed laser signal further comprising coupling the at least

a portion of the pulsed laser signal from the mode-locked laser source to the resonator (figure 1).

With respect to claims 57-61, Hicks teaches an optical resonator having a waveguide formed of a first dielectric material (18) and a cavity defining a variable gap (22) formed of a second dielectric material different than the first dielectric material, wherein the variable gap varies in response to changes in a measurable parameter, the optical resonator receiving light energy from the light source to alter a characteristic of the light energy in response to variations in the variable gap (column 5, lines 5-10).

With respect to claim 63, Hicks teaches the sensing surface being an outer surface of the high Q resonator (column 5, lines 5-10).

With respect to claim 66, Hicks teaches the cavity being external to the waveguide (figure 1).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 9, 13, 28, and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hicks, Jr. et al '087 in view of Ho et al '799.

Claim 9 requires the ring resonator be formed in an optical substrate. Such a configuration is common in the art, as is evidenced by Ho (figures 8 and 9). At the time of the invention, it would have been obvious to one having ordinary skill in the art to form the ring resonator of Hicks in an optical substrate as taught by Ho. The motivation for doing so would have been to provide a smaller waveguide medium (e.g. the substrate of Ho as opposed to the optical fiber of Hicks), thereby reducing the overall size of the system.

Claims 13 and 28 require the waveguide be a microdisc. Ho teaches a waveguide in the form of a microdisc (figure 1). At the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize the microdisc of Ho in the system as taught or suggested by Hicks. The motivation for doing so would have been to minimize the size of the system by utilizing a microdisc as a resonator rather than utilizing an optical fiber.

Claim 62 requires the coupler and the high Q resonator be within a single substrate. Ho teaches such a configuration (figures 8 and 9). At the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize the setup of Ho in the system as taught or suggested by Hicks. The motivation for doing so

would have been to minimize the size of the system by utilizing a single substrate rather than utilizing an optical fiber and coupler.

8. Claims 9, 10, and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hicks, Jr. et al '087 in view of Lin et al US2001/0012149 A1.

Claim 9 requires the ring resonator be formed in an optical substrate. Such a configuration is common in the art, as is evidenced by Lin (figure 11). At the time of the invention, it would have been obvious to one having ordinary skill in the art to form the ring resonator of Hicks in an optical substrate as taught by Lin. The motivation for doing so would have been to provide a smaller waveguide medium (e.g. the substrate of Lin as opposed to the optical fiber of Hicks), thereby reducing the overall size of the system.

Claims 10 and 44 require the ring resonator be formed of a photonic crystal structure. Lin teaches a ring resonator formed of a photonic crystal structure (figure 11). At the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize the photonic crystal ring resonator of Lin in the system as taught or suggested by Hicks. The motivation for doing so would have been to provide a material with desired properties, such as a specific index of refraction (see paragraphs 0002-0011 of Lin).

9. Claims 47 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hicks, Jr. et al '087 in view of Dunphy et al '113.

Claims 47 and 53 require forming a first Bragg reflector at the inlet end; and forming a second Bragg reflector at the outlet end. It is well known in the art that Bragg reflectors are often utilized as end reflectors of a resonator, as is evidenced by Dunphy (20 and 30 in figure 1). At the time of the invention, it would have been obvious to one having ordinary skill in the art to utilize Bragg reflectors as taught by Dunphy in the system as taught or suggested by Hicks. The motivation for doing so would have been to provide end reflectors with desired physical properties, such as high reflectance at a specific frequency range.

Response to Arguments

10. Applicant's arguments with respect to claims 1-10, 12-31, and 33-66 have been considered but are moot in view of the new ground(s) of rejection.

Citation of Pertinent References

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following patent application publication further shows the state of the art with respect to optical sensor apparatus: European Patent Application Publication No. 0 571 107 A1 to Lehto, Ari.

Communication Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leith A Al-Nazer whose telephone number is 571-272-1938. The examiner can normally be reached on Monday-Friday, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Don Wong can be reached on 571-272-1834. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LA

Wilson Lee

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PRIMARY EXAMINER